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The Deterioration of Cane After Cutting.

By J. A. Verret and W. R. McAllep.

One of the losses in connection with the production of sugar which everyone has in mind, but the magnitude of which we have locally comparatively little exact information, is the loss in weight and the deterioration of cane after cutting. Tests recently made at this Station indicate that the loss can reach serious proportions within a period of three or four days.

Our attention was directed to this subject by the results obtained when harvesting a variety test this season on one of the plantations. The discrepancy beween figures obtained from the field weights and samples, and those obtained later at the mill, were rather large.

In taking off this experiment, the cane was weighed and sampled by bundles in the usual manner as soon as cut. Afterwards the different varieties were taken to the mill separately, in carload lots, weighed, and the quality of the juices determined. The variance between the field results and those obtained at the factory was for the different varieties as follows:

FIELD RESULTS (EXPERIMENT STATION)				FACTORY RESULTS			
Variety	Tons Per Acre		Quality Ratio	Tons Per Acre		Quality Ratio	% Loss in Avail. Sugar
	Cane	Sugar		Cane	Sugar		
D 1135	54.1	6.6	8.16	50.4	5.6	8.96	15.2
H 109	45.0	5.4	8.44	43.5	4.8	8.99	11.1
Badila	38.4	4.6	8.34	36.8	4.1	9.04	10.9
Yel. Cal.	34.5	4.4	7.88	32.0	3.75	8.55	14.7

Careful checking failed to disclose errors in the work to account for the differences. To investigate the discrepancy an experiment was started at the Makiki plots in Honolulu, the details of which were as follows:

LOSS IN WEIGHT.

About 75 pounds of freshly cut cane was weighed and then spread on the ground in the same manner as the cut cane would lie in the field. This cane was weighed every day, and the loss in weight determined.

DETERIORATION DATA.

The cane was cut in the order in which the stalks occurred in the row, and placed on the ground in the same order. The cane was then made into ten bundles, every tenth stick being placed in the same bundle; that is, sticks Nos. 1, 11, 21, 31, etc., went to bundle No. 1; sticks Nos. 2, 12, 22, etc., to bundle No. 2, and so on, until all the cane was placed in the ten bundles. Each bundle weighed about 75 pounds, and was composed of 35 stalks of cane. The cane was scattered on the ground to resemble conditions of cut cane lying in the field. As soon as finished, bundles Nos. 1 and 6 were run through the mill and analyzed; two bundles were then ground and analyzed every second day, finishing after eight days. Brix, polarization, purity, quality ratio and glucose were determined.

The results of this test, and the meteorological data for the period during which the test was conducted, are given in the following tables:

VARIETY D 1135—LOSS OF WEIGHT AFTER CUTTING.

May 27-June 4, 1919.

Cane Weight—Fresh	100	pounds
" " —1 day old	97.6	"
" " —2 " "	95.5	"
" " —3 " "	93.0	"
" " —4 " "	91.9	"
" " —5 " "	90.7	"
" " —6 " "	90.3	"
" " —7 " "	90.0	"
" " —8 " "	88.0	"

DETERIORATION AFTER CUTTING.

	Brix	Pol.	Pur.	Q. R.	Glucose	Lbs.* Avail. Sugar per Ton Cane	Loss of Sugar	
							Lbs. per Ton Cane	%
Fresh	19.4	17.81	91.3	7.30	0.15	274	0	0
2 days old	20.2	17.48	86.5	7.63	1.05	250	24	8.8
4 " "	20.6	15.72	76.3	9.08	2.86	202	72	27.0
6 " "	21.1	14.61	69.2	10.41	4.11	179	95	34.7
8 " "	21.4	14.20	66.4	11.04	4.78	159	115	42.0

* Based on quality ratio tables and actual weight of cane.

METEOROLOGICAL DATA.

Date	Temp. in Degree F.			Relative Humidity	Prevailing Wind	Sky	Precipitation in inc.
	Max.	Min.	Mean				
May							
27	85	68	76.5	65	Strong NE.	Clear	0.06
28	86	71	78.5	68	" NE.	"	0
29	86	70	78.0	65	Light NE.	"	0
30	89	70	79.5	65	" NE.	"	0
31	81	66	73.5	91	" N.	Partly Cloudy	0
June							
1	82	65	73.5	75	Light N.	Clear	0.09
2	84	67	75.5	91	" E.	Partly Cloudy	0.53
3	89	67	78.0	64	" NE.	Clear	0
4	87	67	77.0	65	Strong NE.	"	0

Because of the large losses indicated, the experiment was repeated, using two other varieties which were then available, Lahaina and H 109.

The procedure followed was the same as in the first test, except that the weight of the bundles was about twice as much as before. The work with the two varieties of cane was carried on simultaneously. The results obtained are given in the following series of tables:

LOSS OF WEIGHT AFTER CUTTING.

June 24-July 2, 1919.

	Lahaina	H 109
Cane Weight—Fresh.....	100 pounds	100 pounds
" " —1 day old.....	96.7 "	97.2 "
" " —2 " "	95.4 "	96.0 "
" " —3 " "	93.1 "	94.1 "
" " —4 " "	91.3 "	92.6 "
" " —5 " "	88.1 "	90.5 "
" " —6 " "	87.5 "	90.1 "
" " —7 " "	85.7 "	87.9 "
" " —8 " "	84.6 "	87.0 "

DETERIORATION AFTER CUTTING—LAHAINA.

	Brix	Pol.	Pur.	Q. R.	Glucose	Lbs.* Avail. Sugar per Ton Cane	Loss of Sugar	
							Lbs. per Ton Cane	%
Fresh.....	19.75	18.27	92.5	7.08	0.25	283	0	0
2 days old.....	20.35	18.32	90.0	7.15	0.79	267	16	5.7
4 " "	21.25	16.65	78.4	8.45	2.98	213	70	24.7
6 " "	21.95	14.71	67.0	10.56	4.98	166	117	41.4
8 " "	22.9	14.41	63.0	11.33	6.02	149	134	47.4

* Based on quality ratio tables and actual weight of cane.

DETERIORATION AFTER CUTTING—H 109.

	Brix	Pol.	Pur.	Q. R.	Glucose	Lbs.* Avail. Sugar per Ton Cane	Loss of Sugar	
							Lbs. per Ton Cane	%
Fresh	18.3	16.63	90.8	7.84	0.40	255	0	0
2 days old	18.9	16.98	89.8	7.73	0.72	248	7	2.8
4 " "	19.3	16.31	84.5	8.27	1.55	224	31	12.2
6 " "	19.95	16.07	80.1	8.64	2.76	209	46	18.0
8 " "	20.45	14.37	70.2	10.47	4.25	166	89	34.9

* Based on quality ratio tables and actual weight of cane.

METEOROLOGICAL DATA.

Date	Temp. in Degree F.			GENERAL OBSERVATIONS			
	Max.	Min.	Mean	Relative Humidity	Prevailing Wind	Sky	Precipitation in inc.
June							
24	87	73	80.0	66	Strong NE.	Clear	0
25	90	70	80.0	75	" NE.	"	0
26	87	73	80.0	75	" NE.	"	0.13
27	85	71	78.0	68	" NE.	Partly cloudy	0.05
28	88	71	79.5	65	" NE.	Clear	0.05
29	89	71	80.0	59	Light NE.	"	0
30	91	66	78.5	63	" NE.	"	0
July							
1	87	72	79.5	65	" NE.	"	0
2	87	71	79.0	59	" NE.	"	0.07

The results obtained in this second test with two different varieties of cane were of the same nature, and tended to confirm the magnitude of the losses indicated by the first test.

Of the three varieties, H 109 showed the least deterioration. The losses of the Lahaina and the D 1135 were roughly about the same. During the first four days after cutting, D 1135 went back faster than either of the other two varieties, showing a loss of 27% of available sugar on the fourth day, while during the last four days Lahaina lost the most.

The available sugar per ton of cane, given in the above tables, was obtained from the quality ratio of the juices. These tables do not take into consideration variation in the fiber content of the cane. In these experiments there was an increase in the fiber content, due to a reduction of the weight of the juice through evaporation. An increased fiber content also tends to lower the extraction. These two factors tend to increase the losses shown in the above tabulations, while the effect of the increased glucose content on the apparent purity probably tends to decrease them.

This work was entirely on unburned cane. It is possible that either smaller or larger losses may be encountered in burnt cane, but we have been unable, so far, to make these tests.

The magnitude of these figures are more or less confirmed by reference to the literature. Noel Deerr* reports the following as the mean of seven experiments conducted by himself on the evaporation of cane when exposed in heaps of about fifty pounds:

Days cut.....	1 day	2 days	3 days	4 days	5 days
Percent loss in weight.	2.19	4.03	5.49	7.37	8.57

He does not report weather conditions during the tests, nor does he state where they were conducted. Our losses in weight were of about the same order as those reported by Deerr.

Weinberg[1] gives the following data, showing the loss of available sugar in cut cane:

Days cut	0	1	2	3	4
Available sugar per 100 A. S. in original sample.....	100	97.3	92.0	78.6	67.9
Total loss of A. S.....	0	2.7	8.0	21.4	32.1
Daily loss of A. S.....	0	2.7	5.3	13.4	10.7

J. A. Hall, Jr.,[2] from experiments conducted in Argentina, with a number of different varieties of cane, pointed out that they did not deteriorate at the same rate, as the following selected list shows:

PURITIES OF THE JUICE.

Variety	Fresh	6 to 8 days	9 to 11 days
Louisiana Striped.....	87.9	82.7	72.1
Java 36.....	84.5	58.2	51.4
Java 234.....	87.3	70.5	60.8
Kavengire.....	83.8	41.1	32.6

Comparatively cold weather prevailed during these tests, the temperature varying from a little above 32° F. at night to 86° F. in the day, with no rain.

Muller von Czernicky,[3] working in Java, found that the purity of the juices of cane stored for five days indoors dropped from 94 to 82, and when the cane was left one day in the field and then stored five days indoors, that the drop was from 94.6 to 74.2 purity.

SUMMARY.

The following two tables are a recapitulation of the losses in weight and available sugar for each variety and for each day:

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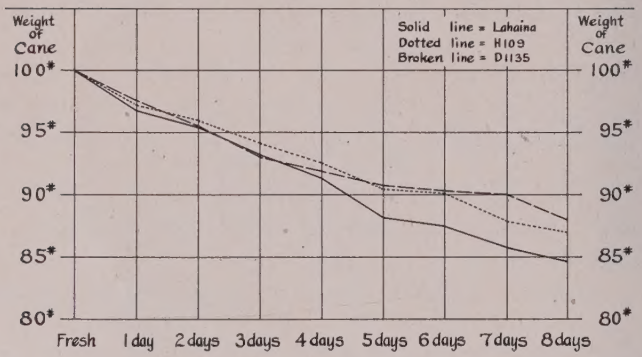
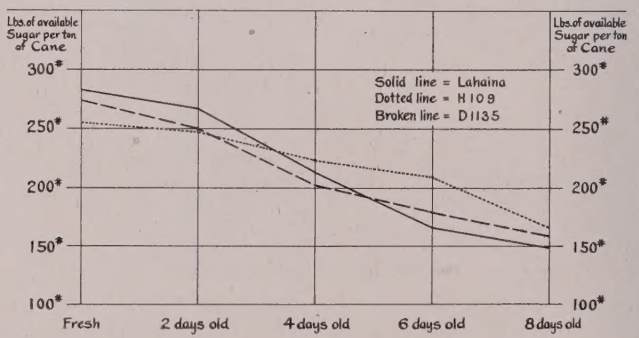
* Sugar Cane, p. 168.
1 Deerr, "Sugar Cane," page 169.
2 Louisiana Planter, Vol LII, No. 15, page 233.
3 Archief, 1900, 610.

LOSS IN WEIGHT OF CANE AFTER CUTTING.
(LAHAINA, H109 & D1135 UNBURNED)





Curves showing loss in sugar from three varieties of cane for varying intervals of time after cutting.

EVAPORATION.

Days cut.....	0	1	2	3	4	5	6	7	8
D 1135 weight in lbs	100	97.6	95.5	93.0	91.9	90.7	90.3	90.0	88.0
Lahaina " " " .	100	96.7	95.4	93.1	91.3	88.1	87.5	85.7	84.6
H 109 " " " " .	100	97.2	96.0	94.1	92.6	90.5	90.1	87.9	87.0
Mean " " " " .	100	97.2	95.6	93.4	91.9	89.8	89.3	87.9	86.5
% Loss	0	2.8	4.4	6.6	8.1	10.2	10.7	12.1	13.5
% Loss each day...	0	2.8	1.6	2.2	1.5	2.1	0.5	1.4	1.4

LOSS OF AVAILABLE SUGAR.*

	Loss of Available Sugar *			
Days cut.....	2	4	6	8
D 1135.....	8.8	27.0	34.7	42.0
Lahaina.....	5.7	24.7	41.4	47.4
H 109.....	2.8	12.2	18.0	34.9
Mean.....	5.8	21.3	31.4	41.4
% loss for each two days.....	5.8	15.5	10.1	10.0

* Available sugar based on quality ratios, taking into account loss in weight of the cane, but not the increase in fiber due to evaporation.

These figures show a loss of almost 3% a day for the first two days; for the third and fourth days this loss increases to 7.5% a day, and from then on it is 5%. For the entire period the average is 5% per day. If we assume that these figures represent conditions as they are on the plantations, and that all the cane is ground within two days after cutting, we can figure what the saving would be if the cane was ground within one day instead of two, and also what the loss would be if it were not ground till the third and fourth days.

We will take a mill grinding 1000 tons of cane a day with a quality ratio of 8.5 when two days old. From the data presented, we construct the following table:

SUGAR PRODUCED FROM 1000 TONS OF CANE.

Days cut	1	2	3	4
Tons of Sugar Produced.	122	118	109	100
Gain or loss each day (tons)	4 (gain)	0	9 (loss)	18 (loss)

From the above we see that if the cane was ground the first day after cutting, we would gain 4 tons of sugar, while if it is not ground until the third day, we lose 9 tons of sugar, while at the end of the fourth day we are 18 tons behind. If we assume the above average loss of 5% a day, and if all the cane of the Islands was ground a day sooner, we would produce 30,000 tons more of sugar per year.

With present labor conditions, it may not seem practicable or, indeed, possible to bring the cane to the mill sooner than is now being done. At the present time, however, while efforts are made to get the cane to the mill "as soon as possible," a greater amount of attention is usually given to reducing the costs of the different operations, such as cutting and loading. It is but natural that these cost figures should receive the greater amount of consideration, for they are easily ascertained, and, as a matter of fact, are regularly determined, while the cost of a delay in taking the cane to the mill is not, and but little is known as to what the cost of such a delay actually is.

Only a few years ago the mills were obtaining low extractions, and but scant attention was given to the money value of the loss. Such extractions were considered by many as high as could profitably be attained. A realization of the amount of this loss, however, furnished the incentive for a large amount of thought and effort directed toward reducing it. In consequence, ways and means were devised so that 98 and even 99 extractions are now regularly obtained; results that formerly were not considered practical if, indeed, possible. Is it not reasonable to suppose that under similar conditions like effort will provide a method for solving such a field problem, even though a practical solution is not now readily apparent?

It is realized that the figures given are for three determinations only, and that the rate of deterioration is not necessarily the same under other conditions. However, as the losses indicated by even a short delay in grinding the cane after cutting are serious, and are corroborated by such references as could be found, it seemed desirable to publish the results at this time.

It is desirable that this work be repeated on as many plantations, and under as widely varying conditions as possible, at an early date, though it is now rather late for much work to be done this year.* The Experiment Station, through its representatives on the different islands, will cooperate with any plantation planning to conduct such tests, and will render any assistance possible.

The analytical work in these experiments was done by Mr. A. Brodie and Mr. L. L. Lynch. The cutting and preparation of the samples were under the direction of Mr. Y. Kutsunai. Mr. Kutsunai also tabulated the meteorological data.

Deterioration Following a Cane Fire.

The decline in the quality of cane following an accidental fire is shown in data supplied us by Messrs. C. Brewer & Co. The fire occured at Naalehu on April 23, 1919, and the analyses of the juice for the succeeding fourteen days was tabulated by Mr. V. Marcallino, chemist of the Hutchinson Sugar Plantation Company.

By following the table headed "Quality Ratio" (tons of cane per ton of sugar) it will be noted that the quality of the juice remained almost constant for the first four days after the burning, and then dropped gradually at first, rapidly afterwards, but with a constantly increased degree, until the entire lot of cane was finally milled on the fifteenth day following the fire.

By taking the quality ratio of the first four days as a basis, the sugar recovery is calculated and compared with that actualy realized under the damaged conditions of the field. Thus the loss of sugar sustained each day is shown.

Apparently the deterioration of burned cane which is left standing is far less rapid than that which occurs in cut cane, even when no burning enters into the matter, if we judge by the tests which have been presented on the subject.

The comparative decline in quality between cut cane, burned and unburned, is yet to be determined.

* We have just been informed that an experiment of this nature has been conducted on one of the plantations, using Yellow Caledonia cane, and the losses found were about as great as those reported here.

DATA ON CANE BURNED APRIL 23, 1919, 120 ACRES, AT NAALEHU.

Date Ground	No. Days After Fire	Juice Analysis			Tons Cane per Ton Sugar Quality Ratio	Tons Cane Ground	Tons Sugar Bagged	*Theoret. Sugar at 7.49 Tons Cane per Ton Sugar	Theoret. Tons Sugar	Loss Estimate
		Brix	Pol'n.	Purity						
April										
24	1	19.67	17.56	89.3	7.49	275.8	36.456	37.0	37.0	...
25	2	20.33	18.07	89.0	7.28	268.22	40.982	36.0	36.0	...
26	3	20.05	17.63	88.0	7.53	357.74	38.192	48.0	48.0	...
27	4	19.83	17.47	88.2	7.55	398.96	59.024	53.5	53.5	...
28	5	19.58	16.93	86.5	7.90	428.95	43.710	57.5	54.3	3.2
29	6	19.20	16.53	86.1	8.10	408.58	56.234	54.8	50.4	4.4
30	7	19.92	16.68	83.7	8.12	413.16	49.600	55.4	50.9	4.5
May										
1	8	19.83	16.15	81.4	8.50	420.30	38.006	56.4	49.5	6.9
2	9	19.28	15.31	79.5	9.10	367.10	34.534	49.2	40.4	8.8
3	10	19.33	14.79	76.5	10.30	352.25	38.192	47.2	34.2	13.0
4	11	18.73	14.28	76.2	11.03	327.11	19.840	43.8	29.7	14.1
5	12	18.63	13.46	71.7	12.20	275.45	9.982	36.9	22.6	14.3
6	13	19.08	13.02	68.3	12.55	364.55	17.546	38.9	29.0	19.9
8	15	19.00	12.38	65.1	13.90	173.50	13.578	23.3	12.5	10.8
						4,831.67	495.876	647.9	548.0	99.9

* Theoretical tons sugar at 7.46 tons cane per ton sugar—average quality ratio of first 4 days. The yields of sugar in this column are calculated on this ratio.

V. MARCALLINO,
Chemist.
H. P. A.

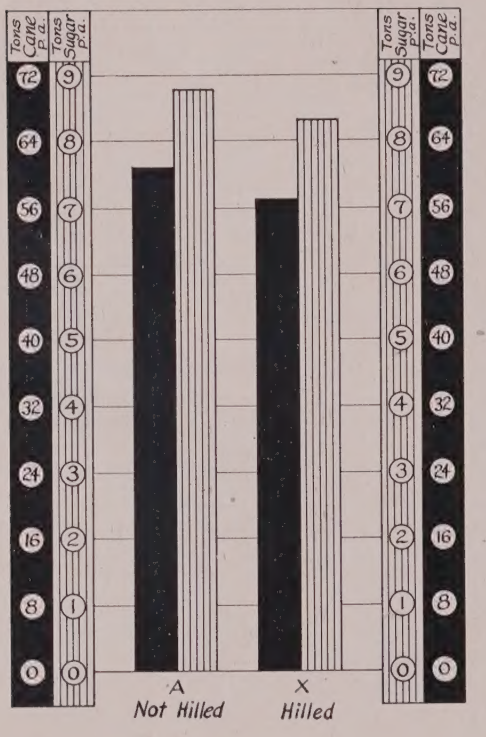
Wainaku Cultivation Experiments.

These experiments consisted of a series of tests comparing—

(1) Hilling vs. no hilling;
(2) Off-barring vs. no off-barring; and
(3) Regular cultivation vs. cultivation for weed control only.

In the hilling and off-barring tests all plots received identical cultivation except that half the plots were not hilled, or not off-barred, respectively. In the regular cultivation vs. cultivation for weed control only, the weeds were controlled by means of harrows and hoes; no plows were used.

We find that in all three experiments the most cane was produced where the least cultivation was done, the largest gain being in the non-hilled plots, where there was not only a gain in cane, but also a decided gain of 0.46 ton of sugar. In the other two tests there was a slight loss of 0.05 ton and 0.12 ton



of sugar where cultivation was omitted, but this loss is well within experimental error. This slight loss was caused by poorer juices. It is interesting to note that in all cases the juices from the cultivated plots were slightly better than that from the other plots. We are not prepared to say whether this better quality of the juices was due to cultivation or merely to the fact that these plots had less cane, and that the cane therefore ripened better, but we are inclined to the belief that it was due to the latter cause.

From these results it would seem, for the conditions under which these experiments were carried out, that animal cultivation, except for weed control, is of doubtful value; this applies especially to the last operation of hilling-up.

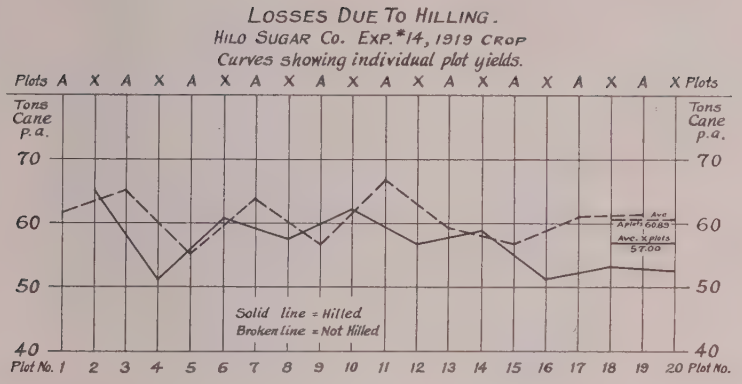
HILLING VS. NO HILLING.

Hilo Sugar Co. Experiment 14, 1919 Crop.*

SUMMARY.

This experiment compares the value of hilling with no hilling. All plots

* Experiment planned by L. D. Larsen.
" laid out by W. P. Alexander.
" harvested by W. L. S. Williams.



received the regular cultivation employed in plantation practice for weed control. This consisted of four harrowings with Horner harrows, two cultivations, and one small plowing. Besides the mule work the field was hoed four times. After the mule work was finished the X plots were hilled up as done in plantation practice, but the A plots were left unhilled.

The following tabulation shows the average yields:

Plot	No. of Plots	Treatment	T. C. P. A.	Q. R.	T. S. P. A.
A.....	10	Unhilled	60.89	6.93	8.79
X.....	10	Hilled	57.00	6.84	8.33
Loss due to hilling...			3.89	...	.46

These results show a loss of 3.89 tons cane and 0.46 ton sugar per acre. Cost figures for the experimental area are not available, but the plantation field costs for this field show hilling-up with mules costs $4.79 per acre. Assuming the net value of sugar as $120 per ton, we have loss due to hilling-up as follows:

Loss of 0.46 ton sugar at $120 per ton.....	$55.20
Added expense for hilling	4.79
Loss in dollars per acre due to hilling.....	$59.99

Rather a large expense for what would seem to be an unnecessary operation.

DETAILS OF EXPERIMENT.

Object—To compare the value of hilling-up against flat culture.

Location—Field 22.

Cane—Yellow Caledonia, second ratoons.

Layout—No. of plots = 20. Size of plots = 1/10 acre, consisting of six lines each 5.3′ x 137′.

Plan—A plots: Not hilled; otherwise regular cultivation. X plots: Hilled and regular cultivation.

Fertilization—Uniform to all plots and applied by the plantation.

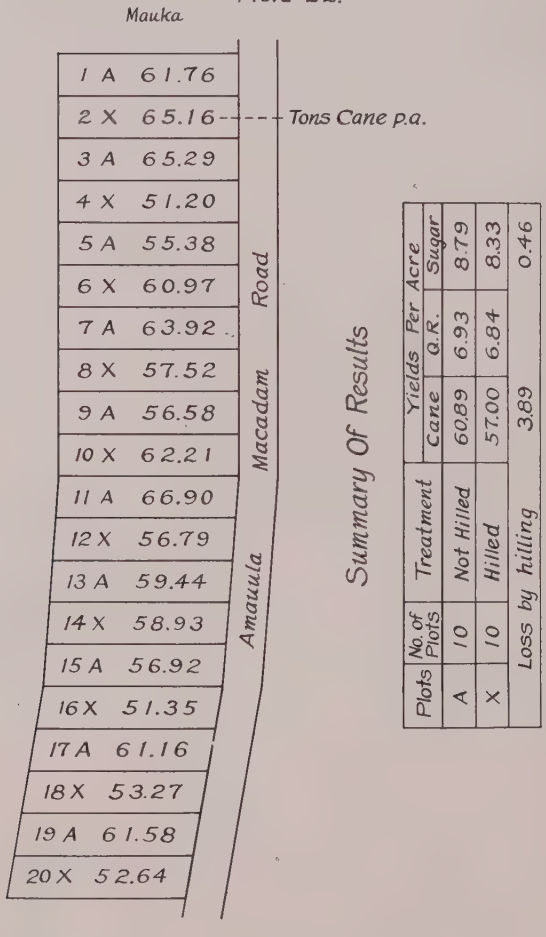
Progress—

July, 1917—Experiment laid out.
January, 1918—X plots hilled.
June 10-12, 1919—Experiment harvested.

HILLING VS. NO HILLING.

HILO SUGAR CO. EXP. 14, 1919 CROP

Field 22.



Summary Of Results

Plots	No. of Plots	Treatment	Yields Per Acre		
			Cane	Q.R.	Sugar
A	10	Not Hilled	60.89	6.93	8.79
X	10	Hilled	57.00	6.84	8.33
Loss by hilling			3.89		0.46

CULTIVATION FOR WEED CONTROL ONLY.

HILO SUGAR CO. EXPERIMENT 15, 1919 CROP.*

SUMMARY.

The object of this experiment is to compare the value of ordinary cultiva-

* Experiment planned by L. D. Larsen.
" laid out by W. P. Alexander.
" harvested by W. L. S. Williams.

tion, including off-barring, small plowing and hilling, with cultivation for weed control only.

The results show no extra yield from the cultivated plots. In this case the work was therefore not profitable. The cultivated plots yielded 55.58 tons of cane and 8.04 tns of sugar, and the uncultivated plots yielded 56.22 tons cane and 7.99 tons sugar. The difference between these yields was well within the limits of experimental error.

The results are given as follows:

Plots	No. of Plots	Treatment	Yields per Acre		
			Cane	Q. R.	Sugar
X	9	Regular cultivation.....	55.6	6.91	8.04
C	9	Cult. for weed control only..	56.2	7.03	7.99

DETAILS OF EXPERIMENT.

Object—To determine the value of ordinary cultivation, including off-barring, small plowing and hilling, against cultivation for weed control only.

Location—Hilo Sugar Co., Field 22, on Amaaula Road.

Crop—Yellow Caledonia, second ratoons.

Layout—No. of plots = 18. Area of plots = 1/10 acre. Each plot consists of six lines, each line being 5.3′ wide and 137′ long. Lines 1 and 6 of each plot should be used as guard rows.

Plan—C plots (all odd plots), after palipali-ing, no off-barring, plowing nor hilling; weeds kept under control by hoeing, and surface cultivation, with high cultivators.

X plots (all even plots) have ordinary plantation cultivation, including off-barring, middle breaking with small plows, hilling-up, etc.

Fertilization—Uniform by plantation.

Progress—

August, 1917—Experiment laid out.
June 21, 1919—Experiment harvested.

OFF-BARRING VS. NO OFF-BARRING.

Hilo Sugar Co. Experiment 16, 1919 Crop.*

SUMMARY.

This experiment was a test of the value of off-barring Yellow Caledonia long ratoons. With the exception of the off-barring all plots received identical treatment.

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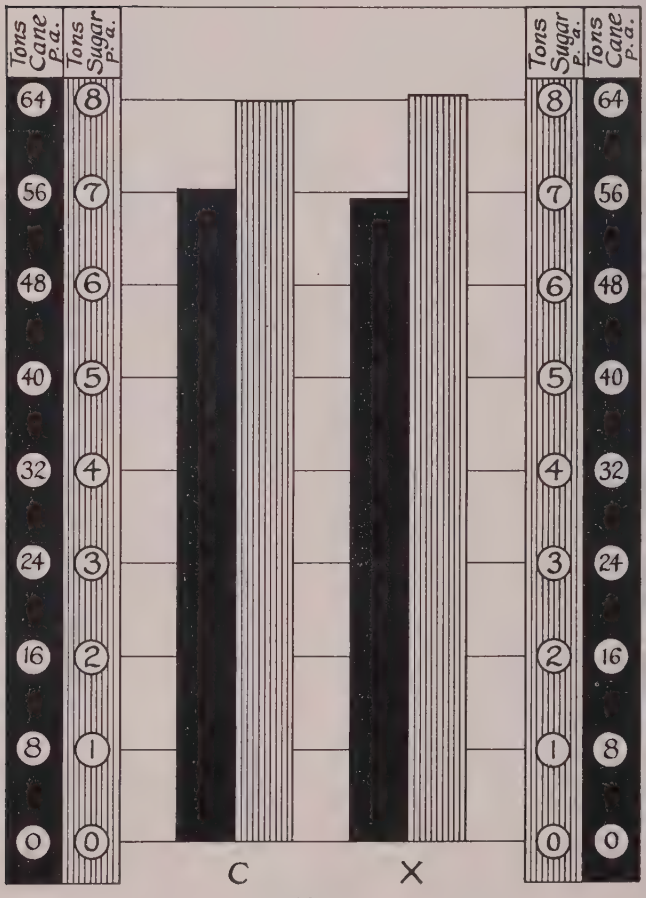
* Experiment planned by L. D. Larsen.
" laid out by W. P. Alexander.
" harvested by W. L. S. Williams.

HILO SUGAR CO. EXP. 15, 1919 CROP

Cultivation–Regular Practice Versus Cultivation For Weed Control Only.

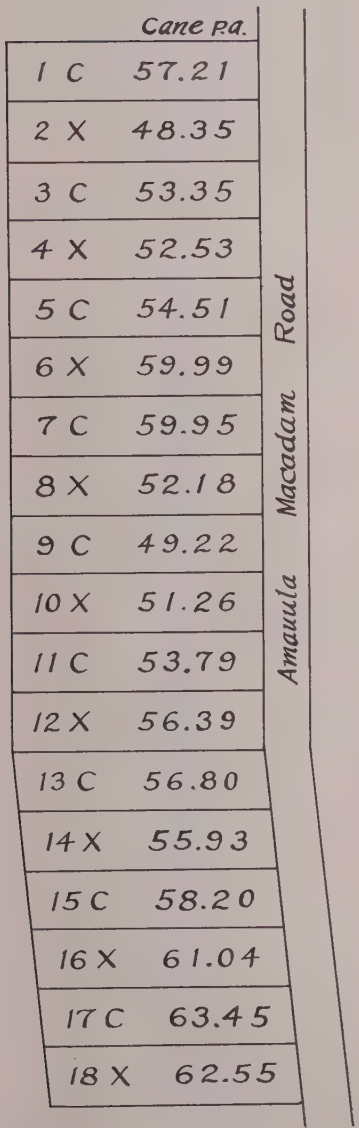


Key :–

C = No offbarring, no subsoiling no middle breaking, no hilling.

X = Regular cultivation.

HILO SUGAR CO. EXP. 15, 1919 Crop
Field 22.
Cultivation – Regular Practice Vs. Cultivation For Weed Control Only.



Summary of Results

Plots	No. of Plots	Treatment	Yields Per Acre		
			Cane	Q.R.	Sugar
X	9	Regular Cultivation	55.58	6.91	8.04
C	8	Cultivation Weed Control Only*	56.22	7.03	7.99

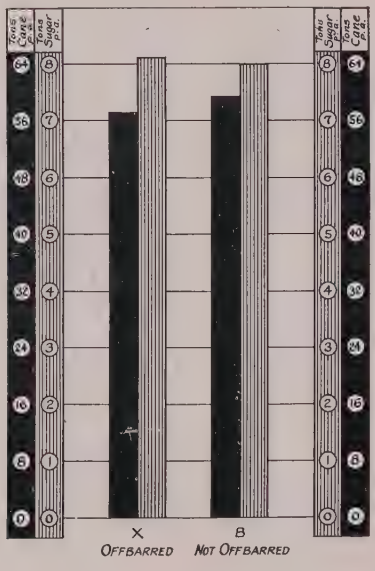
* = No offbarring, no subsoiling, no middle breaking, no hilling.

The results of the harvest are given in the following table:

Plots	No. of Plots	Treatment	Yields per Acre		
			Cane	Q. R.	Sugar
X	9	Off-barred.....	57.10	7.03	8.12
B	9	Not off-barred.....	59.46	7.44	7.99

The differences in yield are rather small and within experimental error. There is a gain of cane from the "not off-barred" plots, but on account of better juices the off-barred plots produced slightly more sugar per acre than did the plots which were not off-barred, but, as before stated, the gain, due to better juices, is too small to be regarded as significant, until it is duplicated in other experiments.

OFFBARRING VS. NO OFFBARRING.
HILO SUGAR CO. EXP. '16, 1919 CROP
Field 22



DETAILS OF EXPERIMENT.

Object—To determine the value of off-barring with ratoon plowing.

Location—Hilo Sugar Co., Field 22, on field path off from Amauula Road.

Crop—Yellow Caledonia, second ratoons.

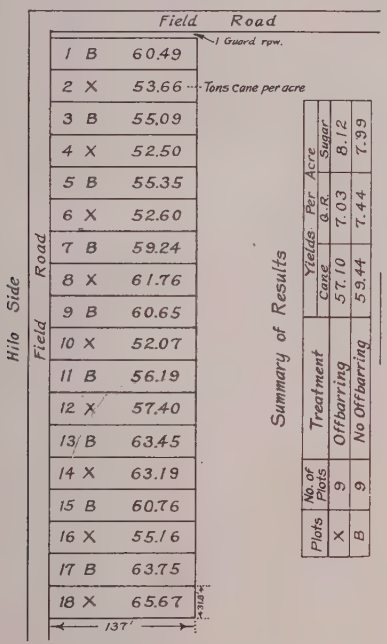
Layout—No. of plots = 18. Area of plots = 1/10 acre. Each plot consists of six lines, each line 5.3′ wide and 137′ long. Lines 1 and 6 should be used for guard rows.

Plan—B plots (all odd) not off-barred after palipali-ing; otherwise regular plantation cultivation, including middle breaking, hilling-up, etc.

X plots (all even) off-barred, middle-breaking, hilling-up, etc.

Fertilization—Uniform by plantation. J. A. V. & R. S. T.

OFFBARRING VS. NO OFFBARRING.
HILO SUGAR CO. EXP. 16, 1919 CROP
FIELD 22.



Summary of Results

Plots	No. of Plots	Treatment	Yields Cane	Per Acre G. R.	Sugar
X	9	Offbarring	57.10	7.03	8.12
B	9	No Offbarring	59.44	7.44	7.99

Potash Shows Gain at Onomea.

ONOMEA EXPERIMENT 8, 1919 CROP.*

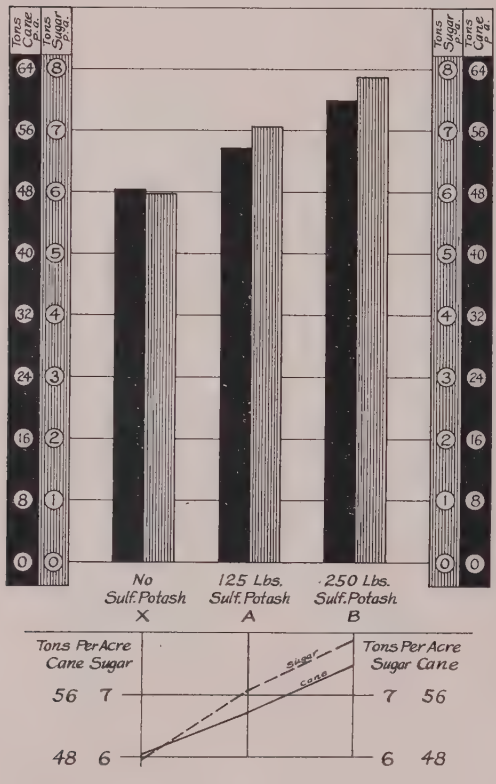
SUMMARY.

The object of this experiment was to determine the value of and amount of potash to apply to plant cane under Onomea conditions. The potash was applied one month after planting at the rate of 0, 60, and 120 pounds of potash per acre.

* Experiment planned by L. D. Larsen.
" laid out by W. P. Alexander.
" harvested by R. Pahau.

GAIN DUE TO POTASH.

ONOMEA SUGAR CO. EXP. *8, 1919 CROP



The subsequent fertilization consisted of a total of 118 pounds of nitrogen, being the same as the plantation practice for plant cane.

The results show very marked increase in yields of both cane and sugar from the potash plots. Sixty pounds of potash per acre increased the yield of sugar by 1.1 tons of sugar, while 120 pounds of potash increased the yield by 1.9 tons of sugar.

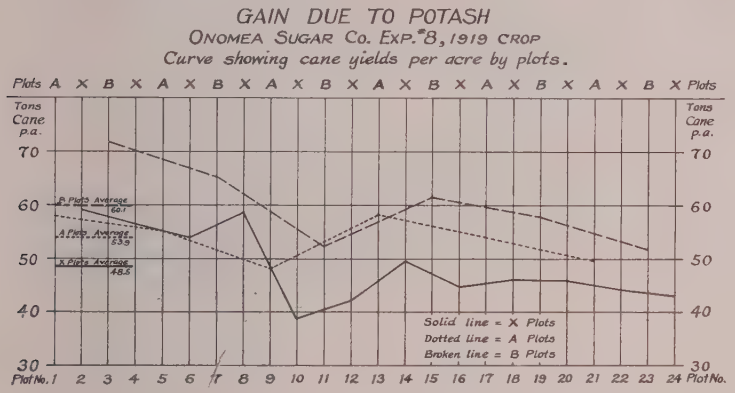
The yields in tabulated form are as follows:

Plots	Lbs. Sulfate Potash per Acre	Yields per Acre			Gain over no Potash	
		Cane	Q. R.	Sugar	Cane	Sugar
X	0	48.5	8.11	5.98	0	0
A	125	53.9	7.61	7.08	5.4	1.10
B	250	60.1	7.61	7.88	11.6	1.90

The natural question is, would greater amounts of potash produce further gains? Unfortunately, there are no higher applications, so this question cannot be answered for the present.

The results of this experiment are in accordance with those of Experiment 6, 1918 Crop.† The larger gains this year from the use of the same amount of potash may be explained by the fact that this potash was applied at the beginning of the crop, while in Experiment 6, 1918 Crop, the potash was not applied until the second season.

We find an analysis of soil in this field, No. 25*, shows a total potash of 0.110%. This is a potash content distinctly lower than is found generally in the soils of the Islands. We must consider this field experiment, and Experiment



No. 6 of 1918 crop, therefore, coupled with the soil analysis, a definite answer to the question of the fertilizer requirements of Onomea soils, which have been cropped continuously for over twenty-five years. Potash is a limiting factor in crop production on these makai soils at Onomea Sugar Co.

DETAILS OF THE EXPERIMENT.

Object—To determine the value of and amount of potash to apply at Onomea.

Location—Field 25, below railroad track and just above the cliff.

Crop—Yellow Caledonia, plant cane.

Layout—No. of plots = 24. Size of plots = 1/10 acre, consisting of six straight lines, each 5.7′x 127.2′.

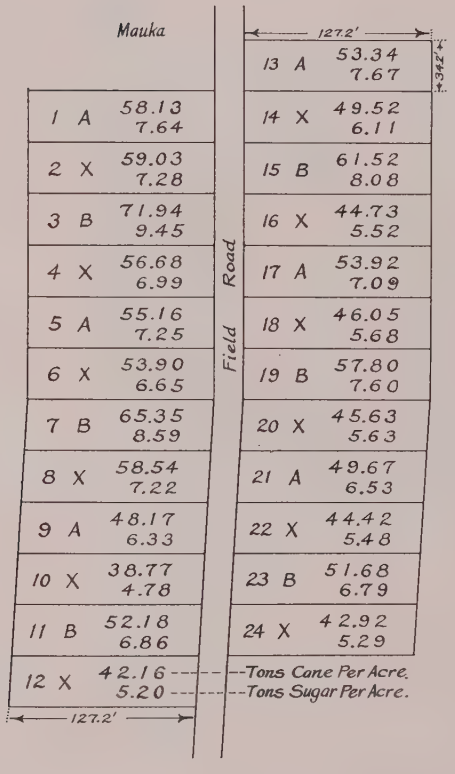
Plan—

Plots	No of Plots	Lbs. Sulfate Potash per Acre	Lbs. K_2O per Acre
A	6	125	60
B	6	250	120
X	12	0	0

† Record, Vol. XIX, p. 242.

* Bulletin 45 by P. S. Burgess, p. 48.

POTASH AMOUNT TO APPLY.
ONOMEA SUGAR CO. EXP. *8, 1919 CROP
Field 25.



Summary of Results

Plots	No of Plots	Treatment	Yields Per Acre Cane	Yields Per Acre Q.R.	Yields Per Acre Sugar	Gain Over No Potash. Cane	Gain Over No Potash. Sugar.
X	12	0	48.5	8.11	5.98	0	0
A	6	125 # Sulfate of Potash	53.9	7.61	7.08	5.4	1.10
B	6	250 # Sulfate of Potash	60.1	7.61	7.88	11.6	1.90

Fertilization—Uniform to all plots.

Progress—

July 21, 1917—Experiment laid out.

July 25, 1917—Sulfate of potash applied.

August 22, 1917—All plots fertilized with nitrate of soda at rate of 200 pounds per acre.

November 27, 1917—Fertilized with B 5 at 400 pounds per acre.

April 15, 1918—Fertilized with B 5 at 400 pounds per acre.

June 24-25, 1919—Experiment harvested.

B 5 = 11% N. (5% nitrate, 5% sulfate, 1% organic).
8% phosphoric acid (5% bonemeal, 3% super.).

R. S. T. -- W. P. A.

TRACTOR IMPLEMENTS USED IN LOUISIANA.

SHAVING RATOON CANE.

This is accomplished by attaching two horizontal discs to standards that can be adjusted vertically.

DESTROYING RATOON CANE.

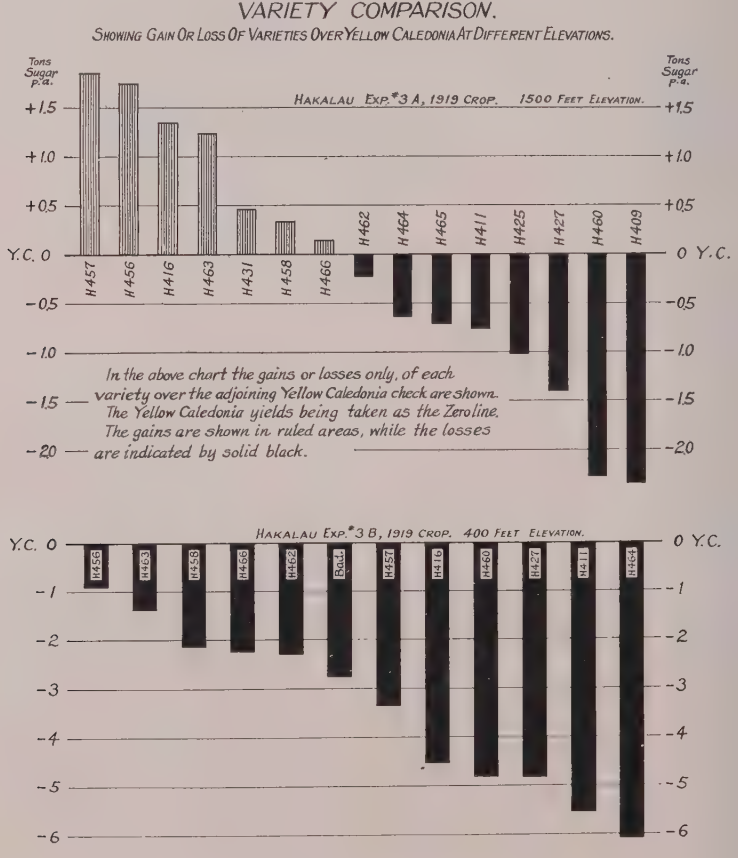
Disc cutting right and left, followed by straight Colter and Double Moldboard Plow.

Test of New Seedlings.

Hakalau Experiments 3a and 3b, 1919 Crop.*

SUMMARY.

These experiments compare the standard variety of cane, Yellow Caledonia, with 15 new H seedlings at different elevations. Experiment 3a is at an elevation of 1500 feet, while 3b is at an elevation of 400 feet. The seed was body seed from one-year-old cane. When planted, a great deal of cane in Experiment 3b failed to come up, so that in some cases only single plots of 1/40 acre were available for harvesting.



The following tables show the yields of each variety, the yield of the adjacent check plots, and the gain or loss of the variety:

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* Experiments planned and laid out by W. P. Alexander.
" harvested by W. L. S. Williams.

EXPERIMENT 3a.

VARIETIES IN ORDER OF THEIR GAIN OR LOSS OVER YELLOW CALEDONIA.
Field 33; Elevation 1500 Feet.

				Adjacent Y. C. Check Plots			Gain or Loss of Varieties	
Variety	T.C.P.A.	Q. R.	T.S.P.A.	T.C.P.A.	Q. R.	T.S.P.A.	Cane	Sugar
H 457...	47.92	7.52	6.37	32.78	7.26	4.51	+ 15.14	+ 1.86
H 456...	48.66	7.36	6.61	35.26	"	4.86	+ 13.40	+ 1.75
H 416...	31.62	7.33	4.31	21.53	"	2.96	+ 10.09	+ 1.35
H 463...	29.30	7.57	3.87	19.10	"	2.63	+ 10.20	+ 1.24
H 431...	34.96	7.14	4.89	32.14	"	4.42	+ 2.82	+ .47
H 458...	42.40	7.58	5.59	38.13	"	5.25	+ 4.27	+ .34
H 466...	32.16	7.37	4.36	30.54	"	4.21	+ 1.62	+ .15
H 462...	24.28	7.24	3.35	25.99	"	3.58	— 1.71	— .23
H 464...	25.92	7.46	3.47	29.90	"	4.11	— 3.98	— .64
H 465...	24.02	7.34	3.27	28.93	"	3.98	— 4.91	— .71
H 411...	15.16	7.73	1.96	19.80	"	2.72	— 4.64	— .76
H 425...	22.00	7.73	2.84	28.05	"	3.86	— 6.05	— 1.02
H 427...	9.98	8.43	1.18	18.77	"	2.58	— 8.79	— 1.40
H 460...	23.22	8.18	2.83	37.08	"	5.11	— 13.86	— 2.28
H 409...	24.34	7.56	3.22	40.43	"	5.57	— 16.09	— 2.35

EXPERIMENT 3b.

VARIETIES IN ORDER OF THEIR GAIN OR LOSS OVER YELLOW CALEDONIA.
Field 10; Elevation 400 Feet.

				Adjacent Y. C. Check Plots			Gain or Loss of Varieties	
Variety	T.C.P.A.	Q. R.	T.S.P.A.	T.C.P.A.	Q. R.	T.S.P.A.	Cane	Sugar
H 456...	48.76	9.17	5.32	49.66	8.12	6.12	— .90	— .80
H 463...	43.84	8.18	5.36	54.21	8.04	6.74	— 10.37	— 1.38
H 462...	42.46	8.48	5.00	56.89	8.04	7.07	— 14.43	— 2.07
H 458...	38.48	8.80	4.37	52.77	8.12	6.48	— 14.29	— 2.11
H 466...	36.74	8.37	4.39	53.97	8.12	6.69	— 17.23	— 2.30
Badila...	26.07	8.14	3.20	48.41	8.12	5.96	— 22.34	— 2.76
H 457...	32.07	8.78	3.28	51.16	8.72	6.63	— 19.09	— 3.35
H 416...	18.85	9.88	1.91	52.21	8.12	6.43	— 33.36	— 4.52
H 460...	18.48	9.25	2.00	52.60	7.72	6.81	— 34.12	— 4.81
H 427...	20.80	10.01	2.08	56.12	8.12	6.91	— 35.32	— 4.83
H 411...	16.19	9.66	1.68	56.18	7.78	7.22	— 39.99	— 5.54
H 464...	13.80	11.35	1.22	59.27	8.12	7.30	— 45.47	— 6.08

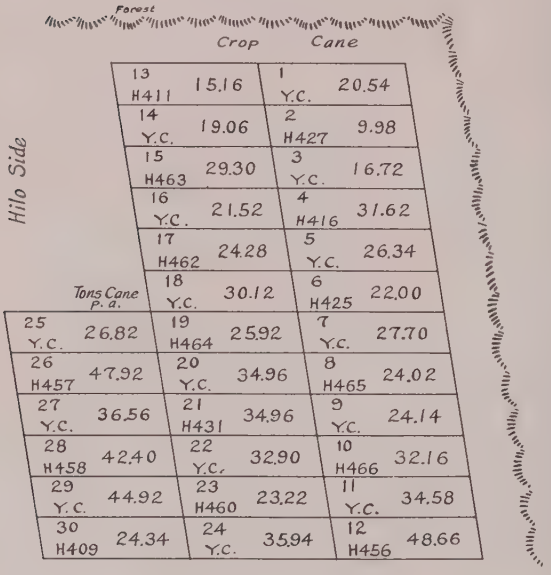
An interesting feature of these experiments is that at 400 feet elevation all these varieties were failures compared to Yellow Caledonia, while at 1500 feet elevation seven of them were equal to, or better than, Yellow Caledonia. Of these seven varieties, four showed very marked improvement over Yellow Caledonia.

VARIETY TEST.

HAKALAU EXPERIMENT *3A, 1919 CROP

FIELD *33.

ELEVATION - 1500 ft.



Summary of Results.

Varieties				Adjacent Yel. Cal. check plots			Gain or loss of varieties	
Var.	T.C.P.A.	Q.R.	T.S.P.A.	T.C.P.A.	Q.R.	T.S.P.A.	T.C.P.A.	T.S.P.A.
H409	24.34	7.56	3.22	40.43	7.26	5.57	- 16.09	- 2.35
H411	15.16	7.73	1.96	19.80	7.26	2.72	- 4.64	- 0.76
H416	31.62	7.33	4.31	21.53	7.26	2.96	+ 10.09	+ 1.35
H425	22.00	7.73	2.84	28.05	7.26	3.86	- 6.05	- 1.02
H427	9.98	8.43	1.18	18.77	7.26	2.58	- 8.79	- 1.40
H431	34.96	7.14	4.89	32.14	7.26	4.42	+ 2.82	+ 0.47
H456	48.66	7.36	6.61	35.26	7.26	4.86	+ 13.40	+ 1.75
H457	47.92	7.52	6.37	32.78	7.26	4.51	+ 15.14	+ 1.86
H458	42.40	7.58	5.59	38.13	7.26	5.25	+ 4.27	+ 0.34
H460	23.22	8.18	2.83	37.08	7.26	5.11	- 13.86	- 2.28
H462	24.28	7.74	3.35	25.99	7.26	3.58	- 1.71	- 0.23
H463	29.30	7.57	3.87	19.10	7.26	2.63	+ 10.20	+ 1.24
H464	25.92	7.46	3.47	29.90	7.26	4.11	- 3.98	- 0.64
H465	24.02	7.34	3.27	28.93	7.26	3.98	- 4.91	- 0.71
H466	32.16	7.37	4.36	30.54	7.26	4.25	+ 1.62	+ 0.15

H 457 gained 1.86 tons sugar over its check plots; H 456 gained 1.75 tons; H 416 gained 1.35 tons sugar; and H 463 gained 1.24 tons. At 400 feet elevation, H 457 yielded 3.35 tons sugar less than Yellow Caledonia; H 456 yielded 0.80 ton less; H 416 yielded 4.52 tons less, and H 463 yielded 1.38 tons less. This emphasizes the often-observed fact that a cane may do poorly on one part of the plantation and well on another.

DETAILS OF EXPERIMENT 3a.

Object—To compare new H seedlings with Yellow Caledonia on mauka lands.

Location—Field 33; elevation about 1500 feet.

Crop—Plant cane.

Layout—No. of plots = 30. Size of plots = 1/20 acre, consisting of four lines, each 95.0′ x 6′.

Fertilization—Uniform to all plots.

Progress—

March 5-6, 1917—Seed cut from Field 14. Body seed taken from year-old cane. Experiment planned and laid out.

July 19, 1919—Experiment harvested.

DETAILS OF EXPERIMENT 3b.

Object—Same as 3a.

Location—Field 10; elevation 400 feet.

Crop—Plant cane.

VARIETY TEST.

HAKALAU EXPERIMENT # 3 B, 1919 CROP

FIELD 10.

ELEVATION 400 FEET.

Summary of Results								
Varieties				Adjacent Y. C. check plots.			Gain or loss of varieties	
Var.	T.C.P.A.	Q.R.	T.S.P.A.	T.C.P.A.	Q.R.	T.S.P.A.	T.C.P.A.	T.S.P.A.
Badila	26.07	8.14	3.20	48.41	8.12	5.96	-22.34	-2.76
H411	16.19	9.66	1.68	56.18	7.78	7.22	-39.99	-5.55
H416	18.85	9.88	1.91	52.21	8.12	6.43	-33.36	-4.52
H427	20.80	10.01	2.08	56.12	8.12	6.91	-35.32	-4.83
H456	48.76	9.17	5.32	49.66	8.12	6.12	- 0.90	-0.80
H457	32.07	8.78	3.28	51.16	7.72	6.63	-19.09	-3.35
H458	38.48	8.80	4.37	52.77	8.12	6.48	-14.29	-2.13
H460	18.48	9.25	2.00	52.60	7.72	6.81	-34.12	-4.82
H462	42.80	8.27	4.40	56.31	8.10	6.95	-17.80	-2.30
H463	43.84	8.18	5.36	54.21	8.04	6.74	-10.37	-1.38
H464	13.80	11.35	1.22	59.27	8.12	7.30	-45.47	-6.08
H466	36.74	8.37	4.39	53.97	8.12	6.65	-17.23	-2.26

27 H462 41.00				
28 Y. C. 58.72				
29 H462 44.92				
30 Y. C. 55.06				
31 H462 41.46				
32 Y. C. 56.88				
33 H411 21.16				
34 Y. C. 60.00	Tons Cane p.a.	(Exp. No. 7.)		
35 H411 10.02	42 Y. C. 63.02	51 H460 23.02	60 Y. C. 46.42	69 Y. C. 37.28
36 Y. C 58.62	43 H463 49.24	52 Y. C. 49.94	61 Y. C. 39.42	70 Y. C. 41.68
37 H411 16.44	44 Y. C. 58.78	53 Y. C. 51.52	62 Y. C. 55.08	71 Y. C. 29.88
38 Y. C. 54.76	45 Y. C. 45.82	54 Y. C. 57.28	63 Y. C. 39.68	72 Y. C. 45.64
39 H411 14.22	46 Y. C. 51.00	55 Y. C. 51.34	64 Y. C. 50.90	73 Y. C. 34.42
40 Y. C. 51.72	47 H463 46.46	56 Y. C. 56.64	65 H457 29.48	74 Y. C. 43.00
41 H411 19.12	48 Y. C. 50.88	57 Y.C. H460 19.70	66 Y. C. 50.60	75 Y. C. 39.88
	49 H463 35.82	58 Y. C. 47.98	67 H460 16.04	76 Y. C. 56.50
	50 Y. C. 54.56	59 H460 15.18	68 Y. C. 49.44	77 H457 34.66

(Exp. No. 4.)

1 H458 38.48	18 Y. C. 47.78
2 Y. C. 57.76	19 H466 44.54
3 H464 13.80	20 Y. C. 57.28
4 Y. C. 62.76	21 H466 37.72
5 H416 18.88	22 Y. C. 55.72
6 Y. C. 55.00	23 H466 27.96
7 H416 18.82	24 Y. C 41.48
8 Y. C. 46.08	25 Bad. 23.80
9 H456 52.38	26 Y. C 46.92
10 Y. C. 47.94	
11 H456 45.14	
12 Y. C. 57.70	
13 Bad. 28.34	
14 Y. C Discard	
15 H427 20.80	
16 Y. C. 56.12	
17 H462 37.20	

Field Road

Layout—

No. of plots (1/20 acre each) = 70, consisting of six lines, each line 5.6′x 64.2′.

No. of plots (1/40 acre each) = 7, consisting of six lines, each line 5.6′x 32.1′.

Note:—The amount of seed available determined the number of plots of each variety.

Fertilization—Uniform to all plots.

Progress—

May 31-June 1, 1917—Seed cut from Field 14. Experiment laid out and planted.
July 2-6, 1917—All plots received 300 pounds nitrate of soda per acre.
October 4, 1917—All plots received 300 pounds nitrate of soda per acre.
February 7, 1918—All plots received 300 pounds nitrate of soda per acre.
May 20, 1918—All plots received 300 pounds nitrate of soda per acre.
May 28, 1919—Experiment harvested.

R. S. T.

Varieties at Paauhau.

Mr. F. M. Anderson has kindly sent us the following results from a variety test at Paauhau:

The varieties planted were D 117, D 1135, H 109, H 20, H 146, H 349, Striped Tip, Yellow Tip, Badila, Striped Mexican and Unknown No. 2 and No. 3. These varieties were planted in February and March, 1917, at an elevation of between 1200 and 1500 feet. The area planted to each variety varied from one-fifth acre to two acres in extent, depending on the amount of seed available.

These varieties were grown under unirrigated conditions, and during 1917 experienced a severe drought. At the end of the first year several varieties looked rather promising, three of them appearing better than Striped and Yellow Tip. The best five varieties, in the order of their growth and general appearance, were as follows: D 117, H 20, D 1135 and Yellow and Striped Tip about the same. There was very little difference between the others. In June, 1918, and again in April, 1919, the H 20, H 109, H 146, H 349 and Unknown No. 3 were cut for seed. The other varieties were allowed to grow to maturity, and when cut this year yielded as follows:

Variety	Area in Acres	Yields per Acre		
		Cane	Q. R.	Sugar
Striped Tip.....	1	47.50	8.58	5.54
D 117.....	2	46.81	8.55	5.47
Badila.....	15/33	38.43	7.83	4.91
Yellow Tip *.....	1	39.75	8.22	4.84
D 1135.....	2	42.13	8.94	4.71
Unknown No. 2.....	1	28.19	9.65	2.92
Striped Mexican....	12/33	26.89	9.38	2.87

* 5 tons seed not included.

R. S. T.

Varieties at Hawaiian Sugar Co.

Through the courtesy of Mr. B. D. Baldwin, we are enabled to give the yields of six varieties of cane growing at Makaweli. With the exception of H 70, rather large areas of each variety were involved, and the harvesting period extended over several months.

H 109 and H 146 lead, with 12.13 and 10.42 tons sugar respectively. D 1135 and Lahaina came third and fourth, with 9.84 and 9.67 tons sugar respectively, while H 20 and H 70 are last, with 8.65 and 5.25 tons of sugar.

A noticeable feature is the uniformly good quality ratio. This is particularly notable with D 1135, for one of the most serious faults of this variety is its poor quality ratio. In this case it compares favorably with the best.

Mr. Baldwin comments on the H 20 as follows:

"Better results would probably have been secured from H 20 if it could have been harvested earlier."

The following table shows the varieties in the order of their yields, and also the dates of harvest:

Variety	Area	Harvest Period	Fiber	Yield per Acre		
				Cane	Q. R.	Sugar
H 109.....	119.34	Feb. 25—June 5.....	12.01	79.64	6.57	12.13
H 146.....	116.85	Feb 25—May 28.....	11.79	68.27	6.55	10.42
D 1135.....	62.94	Mar. 19—June 14....	11.71	64.89	6.60	9.84
Lahaina.....	34.51	Feb. 26—April 2....	11.84	68.39	7.07	9.67
H 20.....	99.46	April 28—June 24....	11.71	60.43	6.99	8.65
H 70.....	1.43	Mar. 8—Mar 11.....	12.55	36.42	6.94	5.25

R. S. T.

The Profitable Limit in Applying Nitrogen.

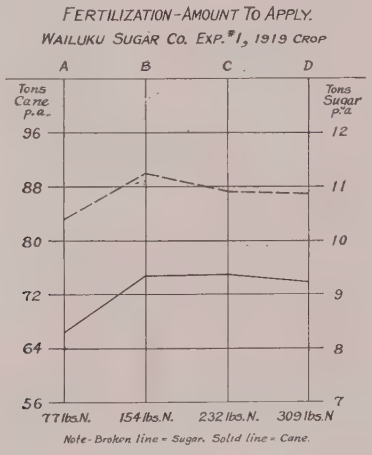
Wailuku Experiment 1, 1919 Crop.*

In this experiment comparison is made between 77, 154, 232, and 309 pounds of nitrogen per acre on first ratoons of Lahaina cane. The fertilizer was applied in four equal doses in August, November, February, and May. In the first two doses it was applied as a mixed fertilizer containing nitrate, sulfate, and organic, while in the last two doses as nitrate of soda. The yields by treatments are as follows:

* Experiment planned by L. D. Larsen.
" laid out originally by Wailuku Sugar Co.
" harvested by L. T. Lyman.

Plots	Lbs. Nitrogen per Acre	Tons Cane per Acre	Q. R.	Tons Sugar per Acre
A	77	66.60	6.41	10.39
B	154	74.96	6.65	11.27
C	232	74.99	6.86	10.92
D	309	74.09	6.80	10.88

The results show a decided gain up to 154 pounds of nitrogen per acre. Further additions of nitrogen produce no increase, but cause a slight falling off due to the poor juices. This crop of first ratoons shows a poorer response to fertilizer than did the plant crop of two years ago. In that crop the increased yields continued up to 193 pounds of nitrogen.

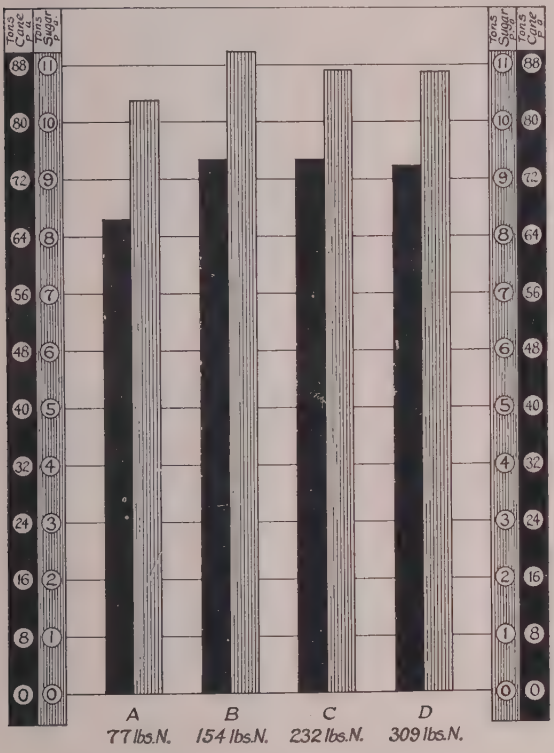


From Experiment 3 we get further confirmation that about 150 pounds of nitrogen is the profitable limit under these conditions. In Experiment 3 nitrogen is obtained from mixed fertilizer and nitrate of soda, and from nitrate of soda alone. Disregarding the form of the nitrogen, and considering only the amounts, the yields give good comparative results. The combined results of Experiments 1 and 3 are as follows:

Plots	No. of Plots	Lbs. Nitrogen per Acre	Tons Cane per Acre	Q. R.	Tons Sugar per Acre	Gain Over No Fertilizer	
						Cane	Sugar
H	6	0	50.65	5.97	8.48	0	0
A	18	77	66.60	6.41	10.39	15.95	1.91
E	18	130	74.54	6.53	11.41	23.89	2.93
F	6	152	74.54	6.34	11.77	24.00	3.29
B	18	154	74.54	6.65	11.27	24.31	2.79
G	6	170	72.81	6.74	10.80	22.16	2.32
C	18	232	74.99	6.86	10.92	24.34	2.44
D	18	309	74.09	6.80	10.88	23.44	2.40

FERTILIZATION—AMOUNT TO APPLY.

WAILUKU SUGAR CO. EXP. #1, 1919 CROP



DETAILS OF THE EXPERIMENT.

Object—To determine the most profitable amount of fertilizer to apply on Lahaina ratoons at Wailuku.

Location—Field 98.

Layout—72 plots, each 1/16 acre (36′ x 75½′), consisting of eight furrows, each 4½′ x 7½′.

Plan—

FERTILIZATION IN POUNDS PER ACRE.

Plots	No. of Plots	Aug. 1917	Nov. 1917	Feb. 1917	May 1917	Total Lbs. Nitrogen
A	18	175#	175#	125#	125#	77
		B 5	B 5	N. S.	N. S.	
B	18	350#	350#	250#	250#	154
		B 5	B 5	N. S.	N. S.	
C	18	525#	525#	375#	375#	232
		B 5	B 5	N. S.	N. S.	
D	18	700#	700#	500#	500#	309
		B 5	B 5	N. S.	N. S.	

N. S. = 15.5% N.
B 5 = 11% N. (5% sulfate, 5% nitrate, 1% organic).
8% phos. acid (5% bonemeal, 3% super.).

WAILUKU SUGAR CO. EXP. #1, 1919 CROP
Field 98.
Fertilization – Amount to apply.

		Level Ditch			
6 90.56 B 13.61	5 71.52 A 11.28	4 71.60 D 10.52	3 79.04 C 11.52	2 77.60 B 11.66	1 75.52 A 11.91
12 77.36 C 11.27	11 76.24 B 11.46	10 62.96 A 9.93	9 73.20 D 10.76	8 72.00 C 10.49	7 76.16 B 11.45
18 85.04 D 12.50	17 65.28 C 9.52	16 65.68 C 9.57	15 64.00 A 10.09	14 67.44 D 9.91	13 70.48 C 10.27
24 66.16 A 10.43	23 69.36 D 10.20	22 66.00 B 9.92	21 74.48 B 11.20	20 69.04 A 10.88	19 77.12 D 11.34
30 77.52 B 11.65	29 51.36 A 8.10	28 66.48 D 9.77	27 76.88 C 11.20	26 74.24 B 11.16	25 68.16 A 10.75
36 78.32 C 11.41	35 72.00 B 10.82	34 64.08 A 10.09	33 70.40 D 10.35	32 81.92 C 11.94	31 78.80 B 11.84
		Level Ditch			
42 75.52 D 11.10	41 85.52 C 12.46	40 79.44 C 11.58	39 72.08 A 11.37	38 86.72 D 12.75	37 83.84 C 12.22
48 60.96 A 9.61	47 76.64 D 11.27	46 67.36 B 10.12	45 74.00 B 11.12	44 73.84 A 11.64	43 74.24 D 10.91
54 72.24 B 10.86	53 63.28 A 9.98	52 72.16 D 10.61	51 75.28 C 10.97	50 75.92 B 11.41	49 69.92 A 11.02
60 80.24 C 11.69	59 65.92 B 9.91	58 61.76 A 9.74	57 66.72 D 9.81	56 79.76 C 11.62	55 72.88 B 10.95
66 71.60 D 10.52	65 66.96 C 9.76	64 67.20 C 9.79	63 59.36 A 9.36	62 70.80 D 10.41	61 64.72 C 9.44
72 70.96 A 11.19	71 69.76 D 10.20	70 78.32 B 11.77	69 79.12 B 11.90	68 73.92 A 11.66	67 88.88 D 13.07
		Level Ditch			

8' Road — 8' Road — 8' Road — 8' Road

Tons Cane Per Acre — Tons Sugar Per Acre

Summary Of Results

Plots	No. of Plots	Treatment	Yields Per Acre		
			Cane	Q. R.	Sugar
A	18	77# Nitrogen per acre	66.60	6.41	10.39
B	18	154# " "	74.96	6.65	11.27
C	18	232# " "	74.99	6.86	10.92
D	18	309# " "	74.09	6.80	10.88

Progress Notes.

August 16, 1917—First fertilization.
December 5, 1917—Second fertilization.
March 5, 1918—Third fertilization.
June 24, 1918—Fourth fertilization.
June 25-26, 1919—Harvested.

R. S. T.

Experiments in Electrical Stimulation of Crops.*

This briefly notes experiments with various crops grown on electrified and non-electrified areas in Calderstone Park, Liverpool, during 1917. The electrical treatment consisted in the discharge of a high-tension current from a series of fine wires suspended above the area. The following table shows the results obtained expressed in percentages of increase or decrease in weight of the electrically-treated crops in comparison with the untreated crops:

EFFECT OF ELECTRICAL STIMULATION OF CROPS.

Crops	Increase (+) or decrease (—) over untreated crops	Crops	Increase (+) or decrease (—) over untreated crops
	Percent		Percent
Beet root	+390	Potatoes—	
Onions	+633	Great Scot	— 13
Peas (late)	+ 29	King Edward	— 2
Carrots (intermediate)	+ 29	British Queen	+ 63
Kohl-rabi	+ 3	Barley	+ 30
Sugar beets	+467	Barley straw	— 18
Mangolds	+219	Oats	+ 39
Swedes	— 16	Oat straw	+ 9
Cabbage	+ 25		

* Experiment Station Record, Vol. 40, No. 3.

[J. A. V.]

WAIPIO EXP. S, 1919 CROP

Fertilizer–Number of applications.

Tons Cane p.a.

Div.	Plots 6 D1135	5 H109	4 D1135	3 H109	2 D1135	1 H109
14	A 49.90	A 55.57	C 58.97	C 52.54	B 51.03	B 50.90
13	C 51.53	C 50.02	B 53.68	B 58.84	A 49.90	A 58.34
12	B 53.80	B 51.16	A 54.18	A 52.92	C 57.33	C 52.79
11	A 49.26	A 46.62	C 52.54	C 51.16	B 57.58	B 56.57
10	C 50.27	C 49.90	B 53.93	B 52.92	A 55.19	A 59.45
9	B 57.71	B 56.07	A 59.22	A 59.35	C 58.46	C 55.57
8	A 52.67	A 49.39	C 49.90	C 55.69	B 56.95	B 60.61
7	C 52.42	C 50.15	B 51.03	B 53.03	A 56.20	A 61.11
6	B 54.43	B 61.61	A 57.83	A 54.31	C 57.71	C 60.10
5	A 52.67	A 64.26	C 55.44	C 58.59	B 59.09	B 61.11
4	C 59.60	C 63.00	B 57.58	B 56.83	A 58.97	A 61.74
3	B 54.81	B 65.14	A 56.07	A 52.29	C 56.83	C 57.08
2	A 53.93	A 60.23	C 56.32	C 54.05	B 61.24	B 59.22
1	C 49.64	C 54.94	B 49.64	B 49.64	A 53.30	A 60.10

Field Road

Summary of Results.

Plots	No. of Plots	Treatment	Varieties	Yields Per Acre Cane	Q.R.	Sugar
A	28	900# Ammonia Sulfate One application	H109	56.62	7.54	7.51
			D1135	54.23	8.40	6.46
B	28	900# Ammonia Sulfate Two applications	H109	56.69	8.05	7.04
			D1135	55.18	9.08	6.08
C	28	900# Ammonia Sulfate Three applications	H109	54.68	8.67	6.31
			D1135	54.78	9.81	5.58

Fertilizer—One Versus Several Applications.

WAIPIO EXPERIMENT S, SHORT RATOONS, 1919 CROP.*

SUMMARY.

This experiment compares the value of applying a given amount of fertilizer in one, two and three doses. The amount and time of applications are shown as follows:

Plot	No. of Plots	July, 1918	Sept., 1918	Oct., 1918	Total Lbs. Nitrogen per Acre
A	28	900# Amm. Sulf.	0	0	184.5
B	28	450# " "	450# Amm. Sulf.	0	184.5
C	28	300# " "	300# " "	300# Amm. Sulf.	184.5

This experiment was conducted on two varieties of cane, H 109 and D 1135. Results show both varieties responding in the same way. The yields of cane did not vary for the different treatments, but the sugar yields were materially better from the single dose, due to better juices. The results by varieties are shown as follows:

Treatment	Variety	Yield per Acre			Gain or Loss Due 2 or 3 doses	
		Tons Cane	Q. R.	Tons Sugar	Cane	Sugar
One dose.....	D 1135	54.2	8.40	6.45	0	0
"	H 109	56.6	7.54	7.51	0	0
Two doses.....	D 1135	55.2	9.08	6.08	+ 1.0	— .37
"	H 109	56.7	8.05	7.04	+ 0.1	— .47
Three doses...	D 1135	54.8	9.81	5.58	+ 0.6	— .87
" ...	H 109	54.7	8.67	6.31	— 1.9	— 1.20

These results corroborate those obtained from this same experiment last year, and published in *Record* Vol. XIX, page 186.

DETAILS OF EXPERIMENT.

Object—Fertilizer: number of applications.

Cane—H 109 and D 1135.

Plots—84, each 1/30 acre.

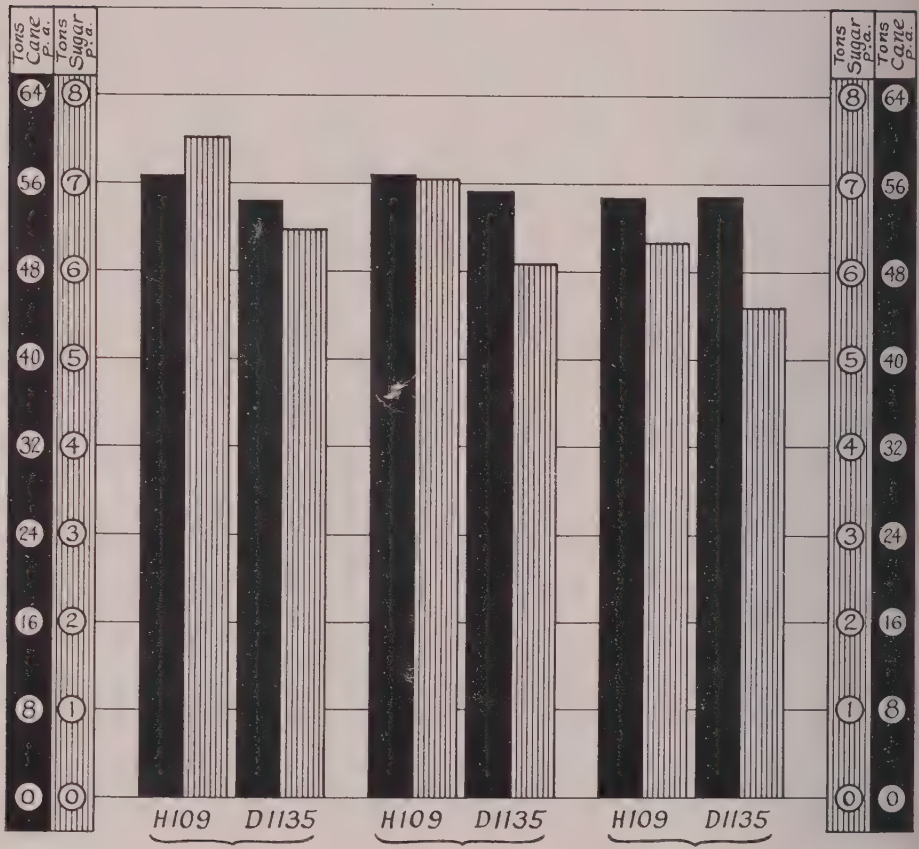
Last crop harvested May 9, 1918; this crop harvested June 9, 1919. Growing period, 13 months.

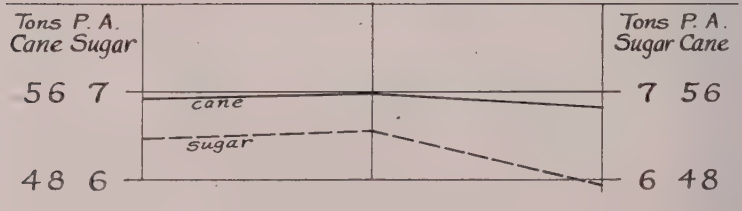
R. S. T.

* Experiment planned by J. A. Verret.
" harvested by R. M. Allen.
Results computed by R. M. Allen.

WAIPIO EXP. S, 1919 CROP

Fertilizer – Number of applications.



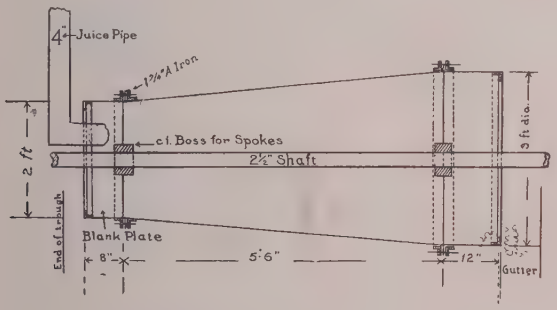


Raw Juice Straining.*

By L. I. Henzell.

Little attention has been given to the straining of raw juice, although it is very important as far as the measurements and the recoveries are concerned, and should be of particular interest to those countries where the weather is very dry, as is the case at Antigua.

During the reaping season of 1917, the fiber in cane was especially high, averaging 17 per cent over the crop, and of such a nature that the amount of cus cus, or small particles of fiber, in the juice appeared in much larger quantity than had usually been the case. An effort was made to remove some of the cus cus by placing a long fine strainer over the measuring tanks, but the quantity of cus cus was more than we were able to cope with, although the juice had previously passed through a mechanical strainer of 1 mm. perforations.



Ends of strainer clipped between angle iron.
Holes in strainer ½ mm.
Revolutions per minute = 32.
Capacity 8000 gallons per hour.
Strainer erected on suitable trough.

It was decided to try a rotary strainer 5′ 6″ long, on a horizontal shaft, and conically shaped—that is, the smaller end 2 feet in diameter and the larger 3 feet. This did excellent work, but discharged the cus cus so freely that a small amount of juice was carried with it. We improved the strainer considerably by adding a foot more length, making this addition parallel to the shaft, and by putting a 1¾-inch angle iron at the discharge end. The additional length and angle iron retain the cus cus sufficiently long to free it almost completely from juice, and deliver it practically dry.

From laboratory tests we find that the strainer removes about 50 per cent of

* Louisiana Planter, Vol. XII, No. 21, May 24, 1919.

the solid matter in the raw juice, and our recovery has increased considerably on what it would have been had we worked a similar juice without straining.

Our grinding plant consists of rotary knives, Krajewski crusher and 12 rolls, and we pass about 8000 gallons of juice through the strainer per hour. The cus cus is discharged before the third mill and gets the benefit of the maceration water behind the third mill.

Juice Before Straining	After Straining
%	%
2.90	1.34
3.54	1.52
3.24	1.44
3.22	1.50
2.32	1.12
Avg. 2.84	1.38

Regarding the value of cus cus as an aid in the subsidence of juice, we are glad to say that we find the juice cleaner and as quick in subsiding as it was before introducing the strainer. We hope to further strain the juice, and anticipate no trouble, as the only foreign matter in the subsided juice is, apparently, fine particles of fiber.

We hope the enclosed sketch will give a fair idea of how our strainer is constructed. [W. R. M.]

THE MANUFACTURE OF BAGASSE PAPER AT OLAA SUGAR CO. FOR USE IN MULCHING SUGAR CANE.

BAGASSE LOFT OF PAPER MILL.

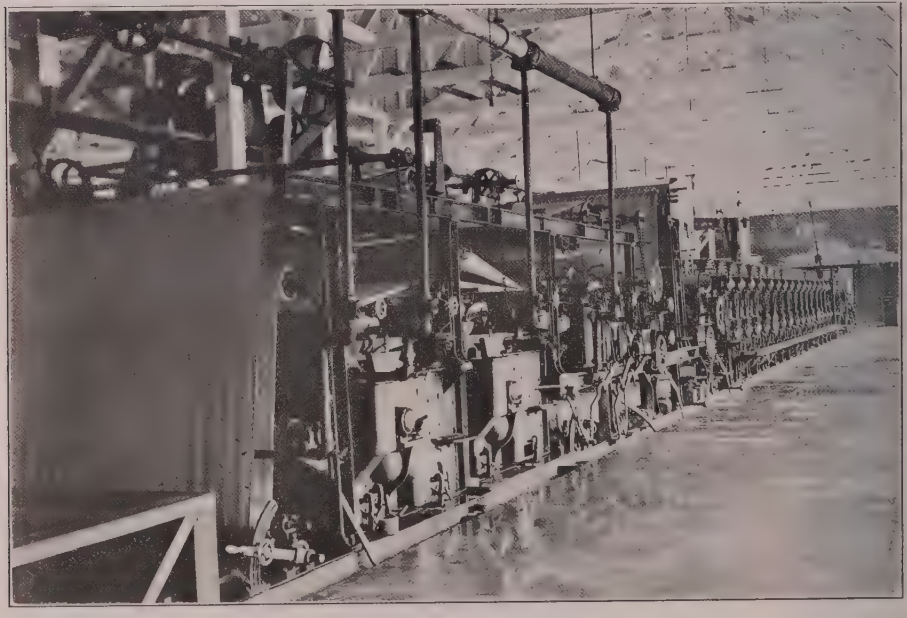
The bagasse comes from the sugar mill by an endless belt conveyor and is deposited on the floor of the loft. The digesters are filled through the trap door.

THE DIGESTER.

There are two of these rotary digesters in which the raw bagasse is cooked for 12 hours with water and two barrels of lime under 60 lbs. pressure. Each digester holds practically 7 tons of bagasse. The cooked material is being discharged from one of digesters in the photograph.

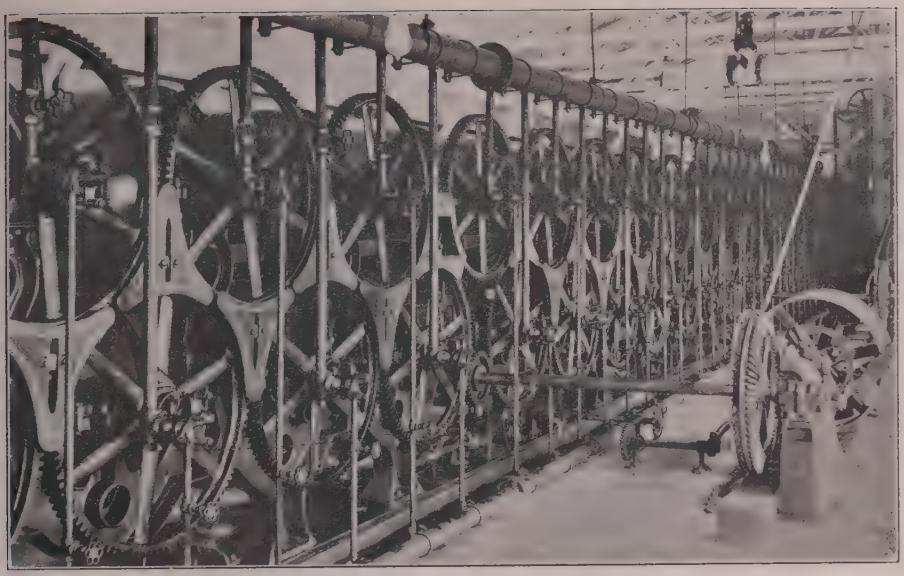
THE BEATERS.

In these tube-like machines the cooked stock is beaten and washed for about four hours. This treatment tends to separate the stock into its ultimate fibers, an action which is subsequently completed by the Jordan engine afer further agitation in a large "stuff" chest.



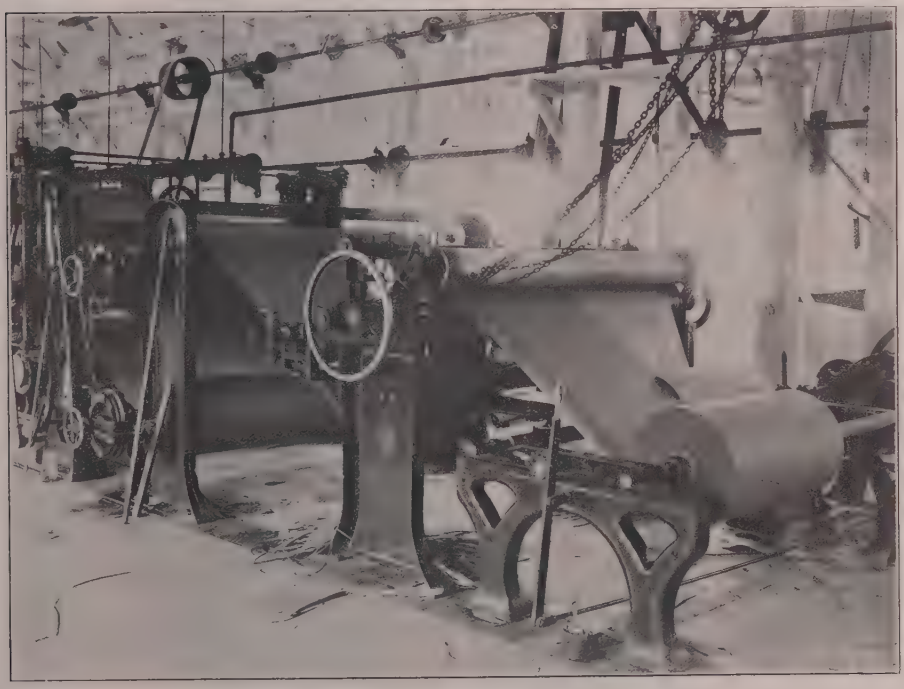
GENERAL VIEW OF PAPER MACHINE.

It is here at the "wet end," shown in the foreground, that the pulp, suspended in water, is deposited on the surface of a revolving wire-cloth cylinder from which it is transferred in the form of an even "web" onto endless felts which convey it through squeeze and press rolls to the drying cylinders shown in the background. The space between the "wet end" and the "driers" is bridged by the paper without the aid of supporting felts.



DRYING CYLINDERS.

The paper passes "over and under" thirty of these steam-heated cylinders imparting with its water and assuming its final shape. The cylinders are carefully mounted and geared to insure the safe carrying of the paper, the last set of fifteen driers running at less speed to allow for the shrinkage.



REWINDING MACHINE.

The paper runs from the drying cylinders into a 72-inch reel. From the reel it is rewound, after trimming and slitting, into two 33-inch rolls of large diameter. These rolls represent the finished "raw" paper which has yet to be saturated with asphalt before it is ready for the field.

ASPHALTING THE PAPER.

The "raw" paper is saturated with asphalt by passing it through a hot bath of this material. As it emerges from the bath it is wound into large rolls in which it stands for 24 hours. These large rolls are then rewound into small rolls of suitable size for handling in the field.

THE PAPER MILL.

This is the structure which houses the machinery of the paper mill. The bagasse carrier coming from the sugar mill is seen entering the superstructure.

THE PAPER IN WAREHOUSE.

Three grades of saturated paper are made, viz., heavy, medium and light. One acre requires between 1300 and 1600 lbs. of paper.

CANE COMING THROUGH MULCH.

This is the way a field appears after the paper has been laid for about 3 weeks. The paper is ready to be slit so as to render the stand uniform. A thick stand is undesirable.

CANE SHOOTS PUNCTURING PAPER.

The basic principle of paper mulching is illustrated here. We see the young shoots of cane penetrating the paper, while all grasses and weeds are smothered. The bursting strength of the paper is between 15 and 20 lbs. per sq. in. when dry and about 5 lbs. per sq. in. when wet. Tough papers, of course, are not suitable.

Cuban Raw Sugars.*

CHARACTERISTICS WHICH AFFECT THEIR AVAILABILITY FOR REFINING.

By W. D. Horne, Ph. D.

QUESTION OF POSSIBLE CHANGES.

The adaptability of Cuban raw sugars to refining has been especially studied of late with the purpose of determining what changes are desirable in the character of some of those sugars and the extent to which such changes may be made with mutual benefit to raw sugar maker and to refiner.

Raw sugar producers and refiners naturally view the subject of raw sugar production from different angles, but it is quite evident that in certain instances the raw sugar producer can gain advantage for himself by bearing in mind the needs of the refiner and somewhat modifying some of his processes to meet them.

Concerning raw sugar the principal items of interest are:

To the Maker—Volume of product, polarization, water, cleanliness, size of grain, hardness of grain, odor.

To the Refiner—Purity, cleanliness, water, color, size of grain.

PURITY MORE THAN POLARIZATION.

The refiner cares more for purity than polarization and dried raw sugars are detrimental to his interests in buying, as in the case of Hawaiian sugars. All agree that the moisture should not exceed 25 per cent or 35 per cent of the non-sugar, so as to avoid the growth of yeasts, moulds, bacteria, etc., causing fermentation. Cleanliness, or freedom from insoluble impurities, is of value to the producer because clean sugars keep better.

To the refiner this same reason has weight, but further importance attaches to insoluble impurities, because they seriously impede defecation and bag filtration or filter pressing. A large grain carries less molasses, purges and washes more easily, and is of advantage to both.

Color is of great importance to the refiner, but it is not particularly considered in the making of some raw sugars. Excessive color impedes char filtration and necessitates a higher amount of sucrose in yellow sugars than usual, in order to maintain the color grades. Further, a higher ratio of invert sugar to ash is distinctly of advantage to the refiner, while it is of much less importance to the raw sugar producer whose process of manufacture is sometimes such as to decompose invert sugar.

In order to find whether these somewhat different interests could be brought nearer together, a brief study was recently made of conditions on some Cuban sugar estates, principally with respect to defecation and pan boiling, as these two divisions of the work have the greatest influence upon the sugars produced.

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* Facts About Sugar, May 31 and June 14, 1919.

CLARIFYING PRACTICE IN CUBA.

In clarifying Cuban juice lime and heat are usually the only agents employed. The juice is always pretty strongly acid, and this must be neutralized before heating, to prevent inversion. The amount of lime used for this is of vital importance. Lime added to neutrality to litmus only, will prevent inversion, but will not completely precipitate a quality of albuminous and other matters which give trouble all along the line.

If lime be added to alkalinity to phenolphtalein, however, which generally means from two to three times as much, a great deal more impurity is precipitated, but the color of the solution is apt to be greatly darkened, and on heating the solution there is a partial destruction of invert sugar with a corresponding accumulation of organic non-sugars in the low products. In examining Cuban juices it was found that at the western end of the island the juice required less lime for a full neutralization to phenolphtalein than did the juice at the eastern end, although both required about the same for neutralization to litmus. These relations may be expressed very closely as follows:

	Western	Eastern
	gm.	gm.
House lime required to neutralize 100 cc. juice to litmus	.02	.02
Lime required to neutralize to phenol	.04	.065
Lime required for full precipitation	.035	.035
Lime used on 100 gms. juice in mill	.0285	.063

The first three items are taken from special determinations in the laboratories and the amounts of lime used in the factories on raw juice are the figures given by the superintendents of the plants.

The western juice had a purity of 86.35, while the eastern was 85.30. The western juice contained 1.39 per cent organic non-sugars, while the eastern contained 1.75 per cent, and this additional organic matter is reflected in the larger amount of lime required to produce alkalinity to phenolphtalein when this is used as an indicator.

SPECIAL TEST OF WESTERN JUICE.

From these experiments it is concluded, however, that only a little more lime would be needed to precipitate the precipitable matter in the eastern juice than that required by the western. This was substantiated by a special test in which 0.03 gram of house lime was boiled with 100 cc. of raw juice and filtered. This gave a good defecation and the juice was light colored. Adding more lime to the clear juice gradually darkened it very much, without producing any more precipitate than a faint cloud, although lime was added to full alkalinity to phenolphtalein and boiled.

The plain inference is that the dark color of some of the Cuban sugars is primarily due to this over-liming. Very high temperatures or unduly prolonged heating will increase this tendency to darken. Especially to be avoided where possible, is a combination of over-liming and over-heating. Evidently this high lime and high heat destroy much of the invert sugar, producing dark-colored substances which affect the sugar disadvantageously and pass into the final molasses as organic non-sugars.

IMPORTANCE OF PROPER LIMING.

How important this latter is may be judged from the fact that some factories working with juices containing about 0.30 per cent of ash and 0.62 per cent invert sugar so strongly limed their juices that the residual molasses contained only about two-thirds as much invert sugars as usual and nearly one and a half to two and a half times as much organic non-sugars as are generally present. This is disadvantageous to both maker and refiner, and it would seem very desirable, if possible, to change such conditions so as to lessen the color and prevent as much as possible destruction of invert sugar. This calls for less lime, with possibly less heat and certainly sufficient settling capacity for a somewhat longer subsidence.

In defecating juice from burnt cane and unusually acid juice it has been found of advantage to use only the customary amount of lime and to supply the remaining alkali needed in the shape of sodium carbonate. This avoids the presence of excessive amounts of lime salts in the sugar solutions and is helpful in several ways.

PURIFYING BY DEFECATION.

The degree of purification effected by defecating raw juice is usually quite small. In some cases, however, reports indicate large improvements, as much as two or three degrees rise in purity between raw juice and concentrated juice. The change ordinarily is not far from one-half to a degree. To test this, insofar as the defecation goes, purities were determined on juice before and after defecating at the customary alkalinity, with the result that it showed 0.50° improvement in western and 0.27° in eastern juice.

Next to defecation, the operation most important to consider here is boiling the sugar. Various modifications are in use at different estates, and each has its advantages and its drawbacks. The method employed by a number of factories consists in boiling first sugar from a seed grain of third sugar (20-25 per cent), followed by meladura* and first molasses, according to purities, to give a massecuite of 80-82 purity. The first molasses tests 60-65 purity.

SECOND MASSECUITES.

Second massecuite is also made from third sugar and meladura, cutting the pan when about three-quarters full, finishing with first molasses. The purity of this massecuite is 70-73 and the second molasses 53-60. Third sugars are grained very low in the pan (20 per cent) on meladura and built on with second molasses, sometimes cutting to two pans and finishing on second molasses so as to reduce the massecuite to 60. The final molasses tests 32-36. The third sugar, thinned with first molasses, is used for seed grain.

The time of boiling is four hours for first and second sugars and six or eight hours for thirds. The sugars made in this way are greatly affected in color by the color of the juice, if it be dark, while sugar made from a light juice is light colored and well liked at the refineries.

The great advantage of this process lies in its economy. Its disadvantages

* Syrup (W. R. M.).

are due to the low goods which it brings back to first sugars, causing part of the mass to be boiled over more than in some other methods.

At another estate a different method of boiling is in use. There the first sugar is grained on meladura, cutting the pan once or twice, following with first molasses. The purity of the massecuite is 79-82 and its final density 92 Brix. The mixed pans are grained on meladura, cutting over and following with more first molasses than before, making a massecuite of 72-74 purity and 93 Brix density, with molasses of 52-55 purity. The third sugars are started low in the pan on cuts from other pans and finished with second molasses with a purity of 61-63 for the massecuite. This third sugar is purged, mixed with first molasses, going to the crystallizers as a massecuite. From here it is drawn into the pan and built on with meladura to a massecuite of 76-77 purity and purged as first sugar. The mixed sugar made by this process is of clean, light colored appearance and of good grain, and gives very satisfactory results in refining.

ANOTHER ESTATE'S METHOD.

Still another modification is the method employed at another estate where they made a very poor sugar for refining last year, but are making a very good sugar this year, having changed their method of manufacture. The first sugar is boiled from meladura and purged. The second sugar is grained on meladura and built up with first molasses. This is purged separately, giving a second sugar polarizing about 95.5 to 96, and a second molasses. The third sugar is grained on meladura and built up with second molasses. This yields a final molasses and a third sugar (amounting to about 16 per cent of the total sugar). This third sugar is melted in hot juice at 185° F. and returned to cold juice, where it is relimed, boiled and defecated like raw juice.

This method of starting all sugars on juice and remelting the third sugars gives a very clean, light-colored product. Remelting the third sugar places scarcely any added burden on the boiling department, except that it throws a little evaporating from the multiple effects upon the pans. There appears to be a special advantage in this method for this particular estate, for there is an unusual amount of magnesia in the juice, and magnesia salts tend to crystallize out on the grains of third sugar. These impurities are largely removed by remelting and defecating.

From the above observations a number of conclusions may be drawn. To make raw sugars most acceptable to refiners—

1. Liming of juices should be just sufficient to precipitate all or almost all of the precipitable matter. Liming beyond this should be avoided.

2. The temperature of limed juice should not be raised any higher than necessary to precipitate and sterilize.

3. Sugars should be built upon a light-colored grain and not on grain made from unduly darkened juice or overlaid with a dark layer from low molasses.

4. More decided account should be taken of the color of raw sugar.

5. The greatest weight should be given to cleanliness and moisture content, the next to color, and then to size of grain, etc.

The Cuban estates are in an unprecedented state of prosperity and bear ample evidence of wise and capable administration. Mechanical details and

chemical control have generally reached a very high state of development, with tremendous tonnage of cane ground and very high yields of raw sugar.

Many of the factories produce admirable sugars for refining, and their marks are sought after by refiners. Some, however, for various reasons, turn out sugars which are prone to fermentation or are overcharged with insoluble impurities, or are too dark colored, or are high in ash and low in invert sugar, which are all disadvantageous to the purchasers of these products. These in the long run will not enjoy the demand which would be theirs under more carefully controlled conditions.

Not only is it of interest to the refiners that these conditions should be changed, but the entire Island of Cuba has a very intimate interest in the highest quality being attained in all of this its chief industry, that the whole world may know that Cuban sugars are good sugars. [W. R. M.]

Limestone Action on Acid Soils.

The Experiment Station Record (Vol. 40, No. 3) summarizes, in part, the results of work reported in Illinois Station Bul. No. 212 (by R. Stewart and F. A. Wyatt), as follows:

"An application of one ton of limestone per acre once in three or four years is sufficient to keep the soil alkaline, after the initial acidity has been destroyed by heavier applications. Dolomitic limestone can be used successfully on acid soils, being slightly more effective than high-calcium limestone in neutralizing soil acidity, being more durable, and having no injurious effects on crop yields.

"Results obtained on the Newton field failed to show that finely-ground limestone was more effective in correcting soil acidity than was the total product from a ¼-inch screen, which contained both the final material for immediate use and the coarser material for greater durability. It is stated that this 'mill-run' product appeared to be the most economical form to use, although final conclusions must await further data concerning crop yields."

[J. A. V.]

Nitrate of Soda for Corn in the South.*

Observations for one season on the effect of sodium nitrate upon corn in the South were made in 9 counties in South Carolina, 7 in Alabama and Virginia, 5 in Georgia, and 4 in North Carolina, by the Bureau of Plant Industry in co-operation with the States Relations Service. The nitrate was applied at a uniform rate of 100 pounds per acre after the corn was above the ground, usually after it had attained a height of 18 inches. Classifying the farms as good and ordinary, the results for all tests showed average yields of 30.1 bushels per acre without nitrate, and 39.4 bushels with nitrate on the former, as compared with 20.8 bushels without nitrate and 27.5 bushels with nitrate on the latter.

* U. S. Dept. Agr., Weekly News Letter, 6 (1919).

[J. A. V.]